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Timing Matters: Longitudinal Insights into Emotion Regulation Following Life Stress in Adolescence

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Abstract

Adolescence is a period of heightened vulnerability to anxiety and depression, with stressful life events as a robust risk factor for internalizing psychopathology. However, heterogeneity in adolescents' responses to stress suggests that emotion regulation (ER) is a key mechanism underlying vulnerability and resilience. In this mini narrative review, we synthesize evidence linking life stress, ER, and internalizing psychopathology, highlighting rumination as the most consistently supported transdiagnostic risk factor while discussing the growing emphasis on ER flexibility. We then examine how longitudinal methods spanning years, months, and moments have advanced understanding of regulatory processes by addressing complementary questions about developmental trajectories, within-person change, and real-time emotional responses to stress. Finally, we discuss how integrating findings across timescales can inform more precise developmental models and personalized interventions for adolescent internalizing psychopathology. Ultimately, we emphasize that understanding ER and the roles strategies may play in connecting life stress to psychopathology requires matching theoretical questions to the temporal scale at which these processes are expected to unfold.

Introduction

Internalizing psychopathology including anxiety and depression frequently emerges during adolescence[1,2]. Exposure to stressful life events is a robust predictor of adolescent internalizing symptoms[3,4]. However, not all adolescents exposed to stress develop psychopathology, highlighting the importance of identifying mechanisms that confer vulnerability or resilience following life stress exposure. Emotion regulation (ER) is a central candidate mechanism linking life stress and psychopathology[5,6]. ER refers to processes through which people influence the experience, intensity, timing, or expression of emotional responses[7]. Historically, most research examining life stress, ER, and psychopathology relied on between-person designs. While informative, these approaches cannot fully address the inherently dynamic nature of emotional functioning. Understanding how ER shapes adolescents' responses to life stress requires methods capable of capturing change over time. Accordingly, longitudinal research spanning years, months, and moments has transformed understanding of how life stress, ER, and internalizing symptoms interact across adolescent development.

In this mini narrative review, we synthesize relevant literature from databases including Google Scholar, PubMed, and APA PsycInfo roughly spanning the turn of the century to present day. Studies

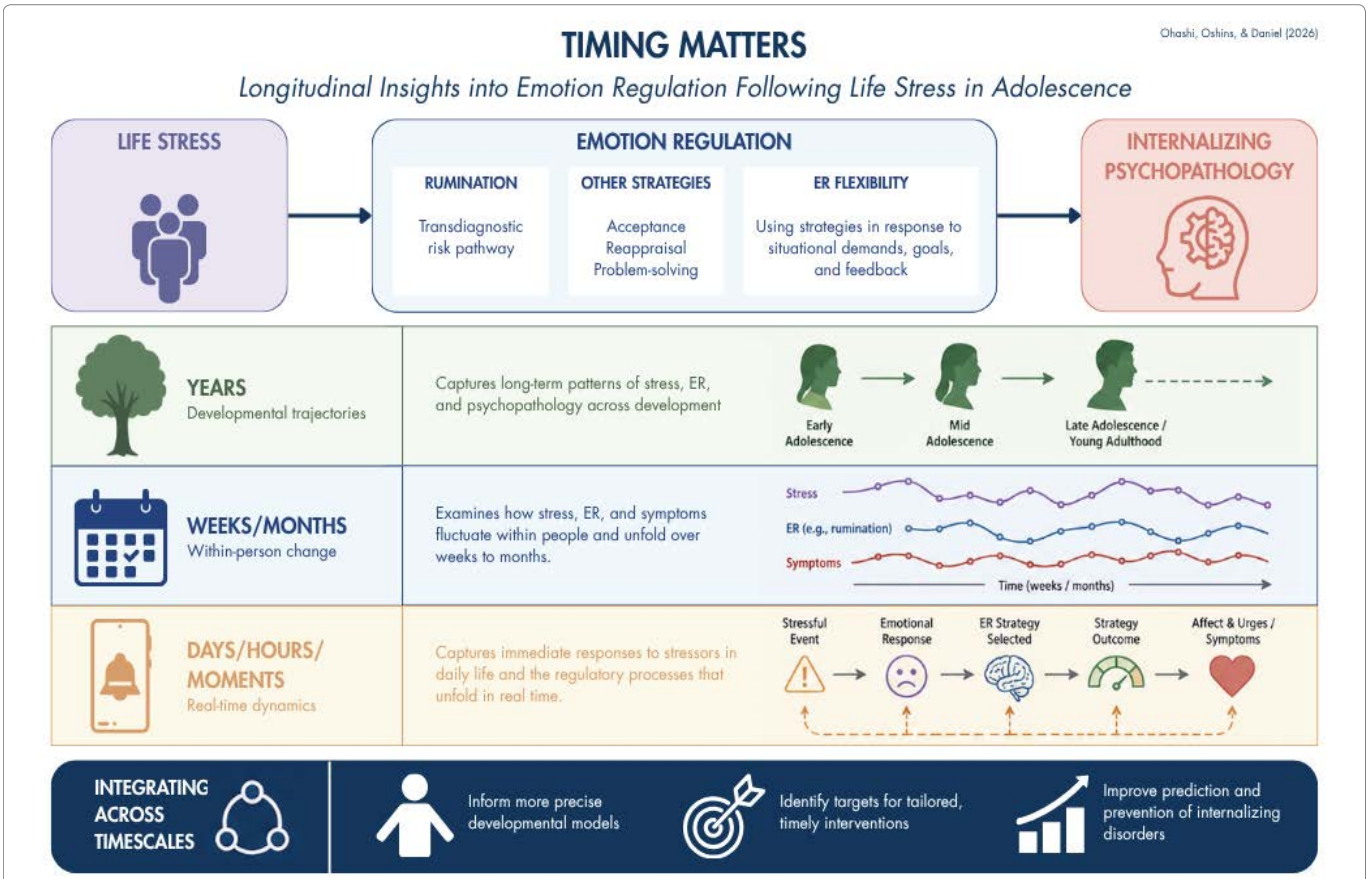

Figure 1:

selected for discussion included relevant terms spanning stress or life stress, ER, internalizing psychopathology or anxiety or depression, adolescence or adolescent development, or longitudinal methods. We identify rumination as a well-supported transdiagnostic risk factor while addressing growing emphasis on ER flexibility. Next, we evaluate how longitudinal methods spanning years, months, and moments have advanced understanding of regulatory processes by addressing complementary questions about developmental trajectories, within-person change, and real-time emotional responses to stress. Lastly, we discuss how—by integrating findings across timescales—future work can inform more precise developmental models and personalized interventions for adolescent internalizing psychopathology. Ultimately, we emphasize that understanding ER and the roles strategies may play in connecting life stress to psychopathology requires matching theoretical questions to the temporal scale at which these processes are expected to unfold.

ER Linking Life Stress & Internalizing Psychopathology

Exposure to interpersonal conflict, peer victimization, family instability, academic stress, and other stressful experiences predicts elevated anxiety and depressive symptoms across development[3,4,8,9]. Importantly, this association is not limited to severe or traumatic events; more normative daily life stressors also contribute to internalizing symptoms during adolescence[10,11]. However, stress exposure does not affect all adolescents equally. ER has emerged as a key mechanism that may help explain this heterogeneity by shaping how adolescents respond to and recover from stressful life experiences.

Among ER strategies, rumination has demonstrated the strongest and most consistent associations with internalizing psychopathology[12,13]. Longitudinal work suggests that adolescents engage in greater rumination during periods of elevated stress exposure, and that rumination in turn predicts increases in internalizing symptoms[14-16]. Further, fluctuations in rumination may partially account for associations between stress exposure and internalizing symptoms within-person over time for both adolescent girls[17] and university students on the later end of the adolescent developmental range[18].

Evidence for other ER strategies including reappraisal, acceptance, and problem-solving has been less consistent. Although these strategies are generally associated with lower internalizing symptoms in between-person studies[19-21], findings suggest their benefits may depend on context, stressor characteristics, and implementation. This inconsistency has contributed to growing interest in

ER flexibility, which emphasizes whether strategies are deployed in ways that are sensitive to situational demands, goals, and feedback. Taken together, this work suggests that the impact of stress on adolescent internalizing psychopathology depends not only on the amount of stress adolescents experience, but also on how they regulate emotional responses to stress in everyday life.

Longitudinal Methods

Cross-sectional and two-wave longitudinal studies have provided foundational evidence that life stress exposure, ER, and internalizing symptoms are closely linked during adolescence. These designs identify between-person associations and primarily address *which* adolescents are at greater risk, rather than *when* changes in stress exposure or regulation predict symptom changes within adolescents.

Longitudinal studies conducted over years are best suited to address questions about developmental trajectories and long-term change. These studies can test how stressful life events predict later psychopathology, how ER strategies forecast subsequent symptoms, and how regulation mediates long-term associations between stress and internalizing symptoms. However, widely spaced assessments may miss short-term stress-response processes characteristic of the regulatory processes in question. Consistent with broader evidence that stress-related internalizing psychopathology unfolds across heterogeneous temporal windows[22-24], the subsequent changes in internalizing symptoms associated with life stress exposure and ER fluctuations may emerge over weeks, months, or longer periods.

Repeated assessments across weeks or months bridge this gap by capturing within-person change with greater temporal precision. Such designs distinguish within-person change from stable between-person differences[25]. Whereas cross-sectional designs can show whether adolescents with one characteristic differ from those with another (interpersonal or between-person), repeated measures designs can additionally test whether fluctuations relative to one's own baseline are followed by subsequent change (intrapersonal or within-person)[25]. For example, intensive longitudinal studies can examine whether greater stress exposure than average is associated with changes in regulatory processes or symptoms over time[17,18,26], rather than simply testing whether a group of higher stress-exposed adolescents differ on outcomes from lower-exposed adolescents. Disambiguating stable individual differences from dynamic within-person change can isolate otherwise enmeshed outcomes. In one large adolescent sample followed into adulthood, associations between psychopathology and ER difficulties were attenuated after accounting for stable between-person differences[27].

Daily diary and ecological momentary assessment (EMA) designs provide a fine-grained view into stress-response processes in everyday life. By assessing life stress, affect, regulation, and symptoms across days, hours, or moments, these methods reduce reliance on retrospective recall and afford more precise temporal sequencing. These designs can address when stress elicits regulatory responses, which strategies adolescents select in specific contexts, and how quickly symptoms shift following stress exposure. EMA studies have demonstrated adolescents' regulatory responses vary across momentary contexts—including stressor type and emotional state[28]—and strategy use and short-term success can diverge across emotional contexts[29], findings made possible by the empirical methods employed.

Conceptual Implications of Longitudinal ER Research

Beyond improving measurement, longitudinal methods have fundamentally reshaped how ER is conceptualized. Rather than merely identifying which strategies are associated with better or worse mental health, these approaches have highlighted the importance of when, why, and under what circumstances regulatory strategies are utilized. Former widely accepted strategy-level classifications (e.g., "adaptive" and "maladaptive") obscured important heterogeneity in how regulation unfolds in daily life. Any given ER strategy may be helpful in one context, ineffective in another, or counterproductive when poorly matched to situational demands[30]. Although evidence remains mixed across operationalization, emerging findings suggest that rigid reliance on any single strategy—even traditionally "adaptive" ones—may confer risk. For instance, poorer ER repertoire and flexibility are associated with depressive symptoms in early adolescence, underscoring the importance of context-sensitive strategy deployment[31].

ER flexibility encompasses selecting and implementing strategies that match situational demands[32,33]. A recent systematic review linked greater ER flexibility to better emotional and behavioral functioning, while noting substantial heterogeneity in measurement[34]. Related work has linked regulatory flexibility with improved emotional functioning, resilience following trauma exposure, and lower anxiety symptoms[35,36].

Regulatory goals and interpersonal context further complicate adaptive-maladaptive classifications. Adolescents may regulate not only to reduce negative affect, but also to avoid conflict, maintain peer belonging, or appear emotionally composed in social settings. Strategy effectiveness may also depend on stressor controllability, chronicity, and perceived agency. EMA work operationalizing flexibility as strategy switching found that adolescent girls' regulatory shifts varied as a function of emotional intensity, perceived controllability, age, and co-

regulatory support[37]. Greater strategy use during periods of distress may reflect regulatory demand rather than regulatory success[29].

These contextual findings carry direct implications for how ER is studied and targeted. Existing retrospective self-report measures may be limited in their ability to capture whether regulatory strategies were successfully implemented or achieved their intended emotional effect. Integrating behavioral tasks[38], EMA to capture real-time regulatory dynamics, physiological indicators, neurobiological measures, digital phenotyping, and passive sensing can provide a more comprehensive picture of regulatory functioning—and one more sensitive to the contextual variability that intensive longitudinal research has revealed. Similarly, findings highlighting contextual variability suggest that interventions may benefit from emphasizing ER flexibility rather than increasing the use of specific strategies in isolation. Greater diversity in ER strategy use is associated with reductions in anxiety-related symptoms in adolescents, particularly under conditions of high chronic interpersonal stress[39], and a proof-of-concept study demonstrated initial effectiveness in improving context-sensitive strategy selection[40]. Teaching adolescents to select and adapt strategies based on situational demands may present a promising intervention target, although further research is needed to establish its efficacy relative to strategy-specific approaches.

Limitations

Despite substantial advances in ER research, several limitations remain. ER measures have relied heavily on self-report, which may be influenced by recall bias or limited insight into regulatory processes. Additionally, variation in how ER is conceptualized and operationalized can make comparison across studies difficult. Similarly, longitudinal research also varies widely in design, measurement frequency, and follow-up duration, which can limit comparability of findings. Moreover, the predominance of cross-sectional or observational designs constrains causal inference regarding antecedents and consequences of ER and connected processes. Critically, the cultural context in which adolescents develop may also shape how stress and emotions are experienced, understood, and regulated. Cultural norms and values can influence preferred ER strategies, expression and communication of emotional experiences, and the extent to which particular regulatory responses are viewed as adaptive or maladaptive. Thus, findings derived primarily from Western samples should not be assumed to generalize across populations, and future empirical research and review work may take cultural differences into account as an important influence on expressions of ER and related mental health outcomes[41]. Finally, a limitation specific to the current mini narrative review includes the possibility of publication or reporting bias. In the effort to concisely synthesize relevant literature to the vast topic area that is the overlap in stress, ER, and internalizing psychopathology and how longitudinal methods may contribute to research and clinical practice—and furthermore, in a narrative rather than a systematic format—the selection of cited literature may be biased in different ways, including a potential overrepresentation of significant findings or the exclusion of other relevant work.

Future Directions

Emerging intensive longitudinal findings provide important implications for prevention and intervention efforts targeting adolescent internalizing psychopathology. First, evidence supports rumination as a potential transdiagnostic intervention target. Rumination-focused cognitive behavioral therapy (RF-CBT) significantly reduced ruminative responding in adolescents with a history of depression[42], and ruminative adolescents who utilized a mindfulness exercise mobile app three times a day for three weeks demonstrated significant reductions in depressive and anxiety symptoms and rumination through a 6-week follow-up[43]. Given its transdiagnostic role, interventions targeting rumination could benefit adolescents across a broad range of internalizing symptoms.

Second, intensive longitudinal methods can support personalized intervention efforts. Real-time assessment technologies such as digital phenotyping and passive sensing are capable of identifying periods of heightened emotional vulnerability and delivering targeted interventions when internalizing symptoms are prone to escalate. Preliminary evidence in adults suggests that just-in-time adaptive interventions (JITAIs) leveraging EMA to identify personalized rumination timing patterns can deliver RF-CBT at moments of heightened vulnerability following stressful life events and reduce the frequency and duration of rumination episodes[44]. Further research is necessary to explore whether JITAI approaches can be appropriately adapted for child and adolescent populations. Combining active and passive longitudinal assessment methods may further increase the accuracy and efficacy of JITAIs and similar efforts.

Third, future research should examine how stress-ER associations vary across adolescence by age, sex, pubertal stage, developmental timing, or socio-cultural contexts. Early adolescence may capture a particularly sensitive period due to pubertal maturation, changing social demands, and ongoing development of cognitive control capacities. Sex differences in ER and stress-related internalizing risk are well-documented: girls report significantly higher rates of rumination than boys[45], rumination mediates stress-related internalizing outcomes more so among girls relative to boys[46], and both pubertal maturation and earlier pubertal timing are positively associated with rumination among adolescent girls[47]. Longitudinal studies spanning multiple

developmental periods and timescales may prove critical for identifying when ER is most susceptible to stress and when interventions may be most effective in preventing the emergence of internalizing psychopathology.

Lastly, the field at large would benefit from an in-depth systematic or scoping review of research examining stress, ER, and internalizing psychopathology across adolescence. While the present mini review collated a broad selection of findings across multiple timescales over the past few decades, its narrative and selective scope may not fully capture the breadth of existing literature.

Conclusion

Stress exposure is a robust predictor of adolescent internalizing psychopathology, yet adolescents differ considerably in how they respond to stressful life experiences. ER is a key mechanism that may explain this heterogeneity, with rumination demonstrating the strongest and most consistent evidence linking stress to subsequent internalizing symptoms. In tandem, growing emphasis on ER flexibility highlights that regulatory success depends not only on which strategies adolescents use, but also on when, why, and under what circumstances. Longitudinal research spanning years, months, and moments has fundamentally advanced understanding of these processes by addressing complementary questions about developmental change, within-person dynamics, and real-time stress responses. Rather than viewing research approaches as interchangeable, future research should align theoretical questions with the appropriate methodological temporal scale at which ER processes unfold. Doing so may help refine developmental models of stress-related internalizing psychopathology, identify more precise intervention targets, and ultimately support personalized approaches to prevention and treatment during adolescence.

Conflict of Interest

None

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Ethics Statement

Not applicable

Author Contributions

Yuri-Grace B. Ohashi (Conceptualization; Methodology; Project administration; Writing – original draft; Writing – review & editing), Katie Oshins (Methodology; Writing – original draft; Writing – review & editing), Naomi G. Daniel (Methodology; Writing – original draft; Writing – review & editing)

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